



# **KTRK Flight Tracking System, VNOMS, Altitudes and Positional Calculations**

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# Agenda

- Noise Complaint Details
  - VNOMS Data and Flight Path
- Flight Tracking and VNOMS System Architecture
- N647QS Flight Path Data
- Accuracies of Noise Complaint System
  - Altitude Calculations
  - Flight Tracking
  - XY Positional Accuracies
  - Google Earth
  - VNOMS
- Conclusions

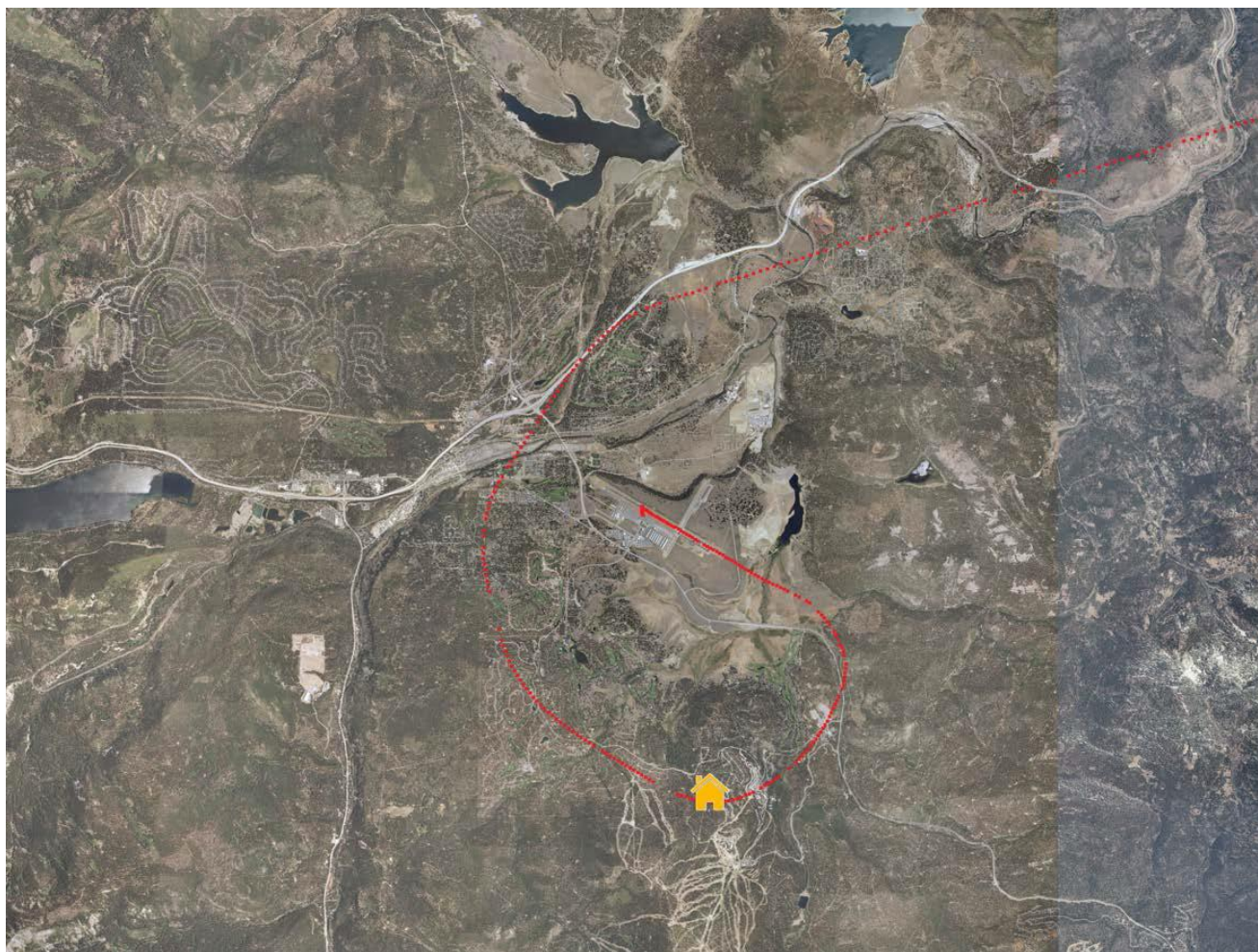


# Noise Complaint

- **COMPLAINT ID:** 6082
- **COMPLAINT TYPE:** Low
- **OPERATION TYPE:** Arrival
- **RUNWAY:** 29
- **A/C TYPE:** C56X
- **DATE AND TIME:** Jul 28 2015, 06:20 PM
- **POINT OF CLOSEST APPROACH(PCA):** 0.08 nm
- **ALTITUDE AT PCA:** 7100 ft



# VNOMS Flight Data





# System Architecture

KTRK  
VNOMS Display  
System

KTRK  
VNOMS Central  
Processor with  
Barometric  
Correction

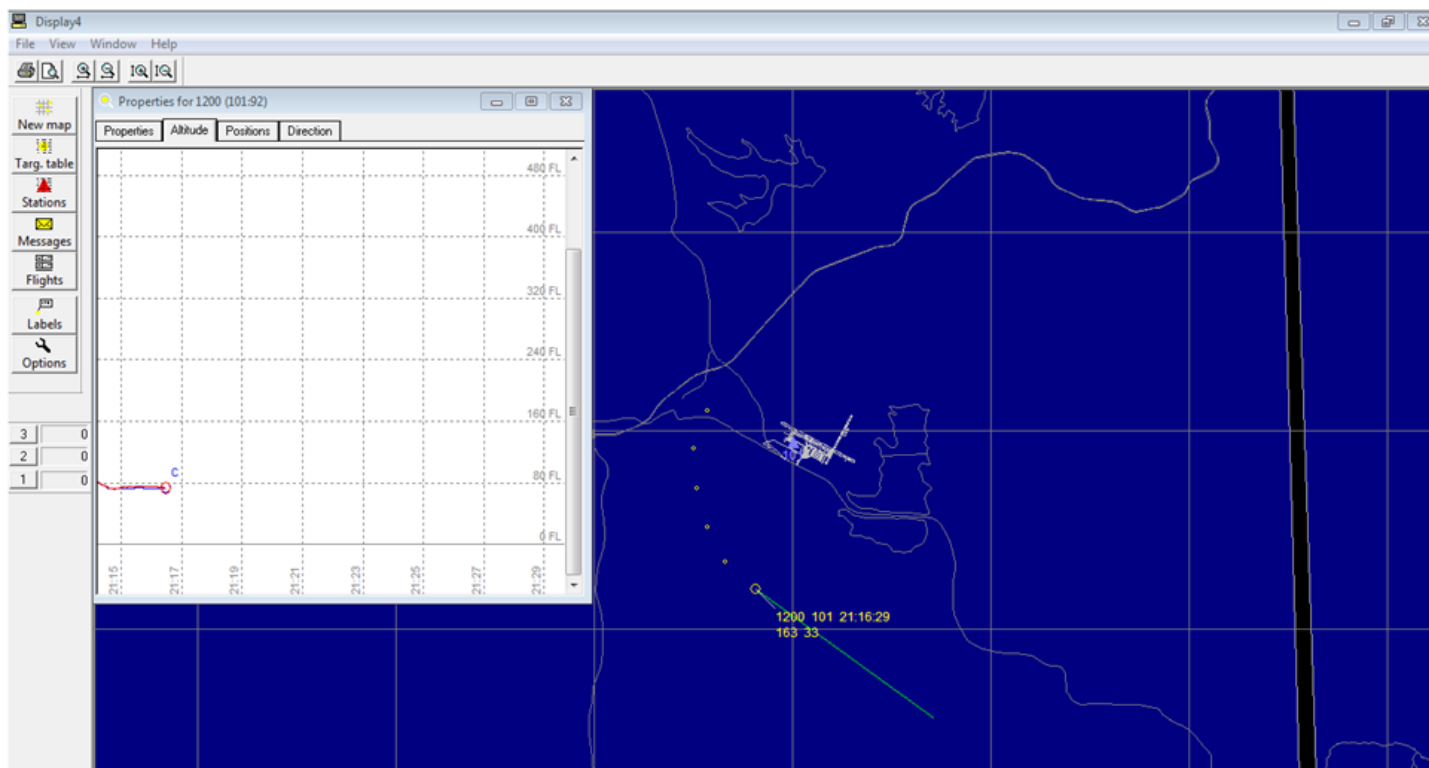
KTRK  
Flight Tracking  
System Raw Data

- VNOMS System
  - Performs Post Processing of Flight Tracks
  - Adds Barometric Corrections to all Flight Tracks
  - Displays Flight Tracks over Satellite Imagery “Google”
- Flight Tracking System
  - Receives Aircraft Transponder Information Mode C Altitude
  - Passes Raw Track Information to VNOMS without Barometric Corrections
  - Uncorrected Barometric “Raw Altitude” Mode C Encoded from Aircraft
  - Calculates Altitude using System Sensors when 4 Ground Stations receives transponder Mode C signal (XYZ Geospatial)



# Mode C Altitude “Target of Interest” N647QS Mode S Code A880AB

## Screen Shot and Video file for Target of Interest



- [..\..\Documents\NavAid\Programs\Truckee\Board Meeting\Altitude Discussion\N647QS\\_rev1.avi](..\..\Documents\NavAid\Programs\Truckee\Board Meeting\Altitude Discussion\N647QS_rev1.avi)





# VNOMS Flight Data

- VNOMS Flight Data





# Flight Tracking System and Aircraft Transponder “Altitude Tolerances”

The following represents accepted tolerances that can occur in reporting aircraft altitudes:

- Aircraft Mode C Transponders
  - +/- 100 Feet
- Flight Tracking System
  - +/- 30 Feet
- VNOMS Tracking System using Google Earth Maps
  - +/- 100 Feet

**References: FAA, System Performance Specifications, Google Forum**





# Google Earth Accuracies

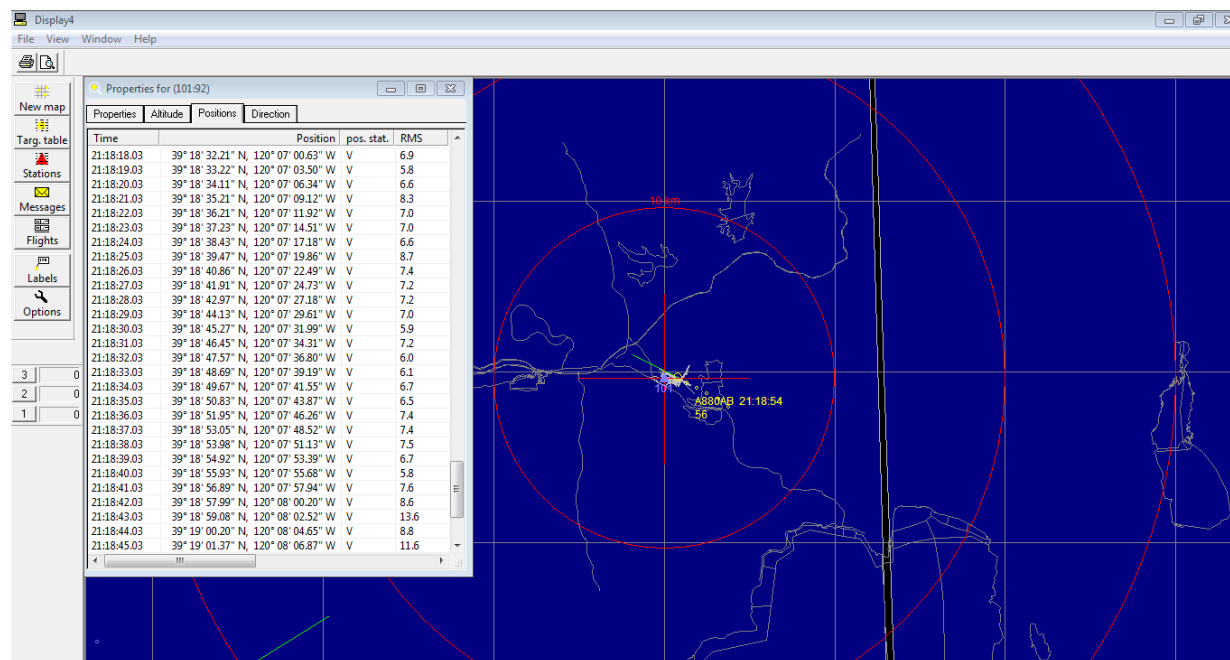
## In accordance with Google's Forum the following Q&A on accuracies are quoted:

- Question: Distance measurements appear very accurate but elevation measurements appear to carry a huge error factor e.g. measuring the elevation of a 3 km long runway gives me 110 m at one end, then it gradually raises to 115 m in the center, then it gradually drops down to 104 m at the other end. I know that the elevation is based on the average terrain elevation but the area used to compute the average elevation must then be very large in order to generate a 9 m error in the above example given that the closest building is 400 m away from the center line of the runway. Does anyone know: (a) the precision we can apply to distance measurements; (b) the area used in computing elevation data; and (c) the precision we can apply to elevation measurements
- Answer: For the benefit of other readers, there is an excellent document on precision of SRTM data at the following link: [http://dds.cr.usgs.gov/srtm/version2\\_1/Documentation/MIL-PDF-89020B.pdf](http://dds.cr.usgs.gov/srtm/version2_1/Documentation/MIL-PDF-89020B.pdf). You are right in saying that we should look at elevation accuracy in Google Earth in the range of **+/- 30 m**. One interesting thing I noticed however is that Google Earth appears to apply an average of many sampled points in order to smooth the data in the horizontal plane (make the terrain look more flat).



# Flight Tracking Accuracies

- Flight Tracking Accuracies (XYZ)
  - 7M RMS within 5 KM of KTRK is ATC Grade Accuracy

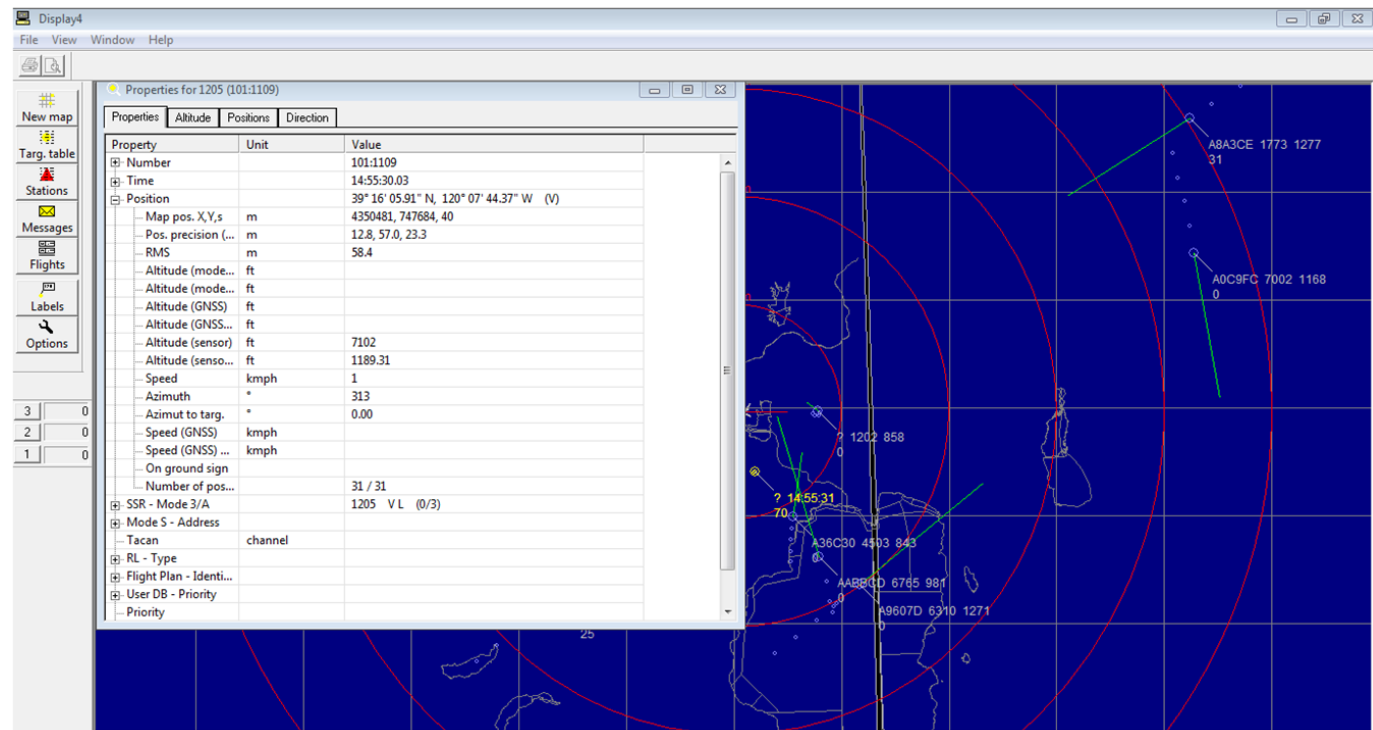


- [file:///C:/Documents%20and%20Settings/NavAid/Programs/Truckee/Board Meeting/Altitude Discussion/20150729\\_010000\\_TP1Cat20.ast](file:///C:/Documents%20and%20Settings/NavAid/Programs/Truckee/Board%20Meeting/Altitude%20Discussion/20150729_010000_TP1Cat20.ast)



# XY Positional Calculations

- To ensure positional accuracies XY, a test was conducted with a portable transponder, WAAS enabled hand held GPS, and the flight tracking system





# XY Positional Calculations

- The following are the results of the tests:
- WAAS GPS Position
  - N39 16.086
  - W120 07.75
  - Altitude 6959
- Portable Transponder as Recorded by Flight Tracking System Squawking 1205
  - N39 16.091
  - W 120 07.44
  - Altitude 7102



# Conclusions

- The Accuracies of the Flight Tracking Data is +/- 10 Meters on Average
  - Flight Tracking Accuracies Increase as You Approach the KTRK Airport
- Flight Tracking System had Target of Interest in Track from 18NM to Arrival on 29
  - 1334 AGL ~2.15 Nautical Miles SW of Runway 29
- Positional Accuracies are within Site Acceptance Test Results see slides 11&12
- Citation 560XL arrival to 29 with a left base turn low over residence. Based on proximity to terrain, the aircraft operator and the local FSDO of the FAA were contacted. An ongoing investigation will continue. All parties, TTAD, FAA, & the Operator, including the commenter are making this a priority